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Experimental evolution of the inland vertical structure of a Coastal Atmospheric Boundary Layer in the Central Mediterranean using surface and ground-based remote sensing measurements

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HEADLINES

- Purpose of the presentation
- Background information
- Experimental setup
- Case studies of the evolution of the vertical structure of the Coastal Boundary Layer (CBL)
- Summary
- Work in progress

PURPOSES OF THE PRESENTATION

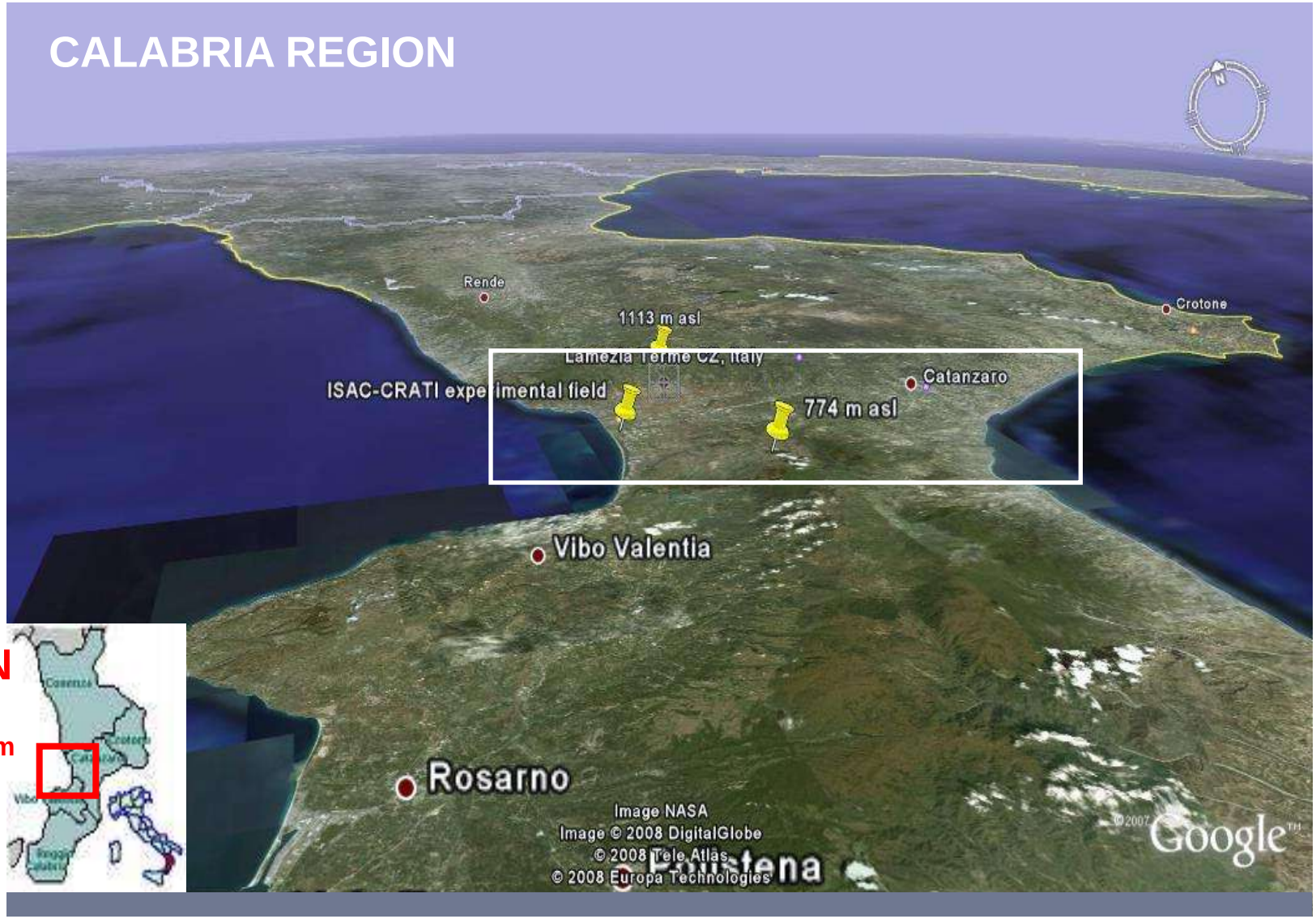
To present a comprehensive database of use for:

- Studying the evolution of the **(BL)** structure at the coast line
- Studying the interaction of synoptic and sea/land breeze systems
- Validating high resolution models

We present two case studies of the evolution of the CBL

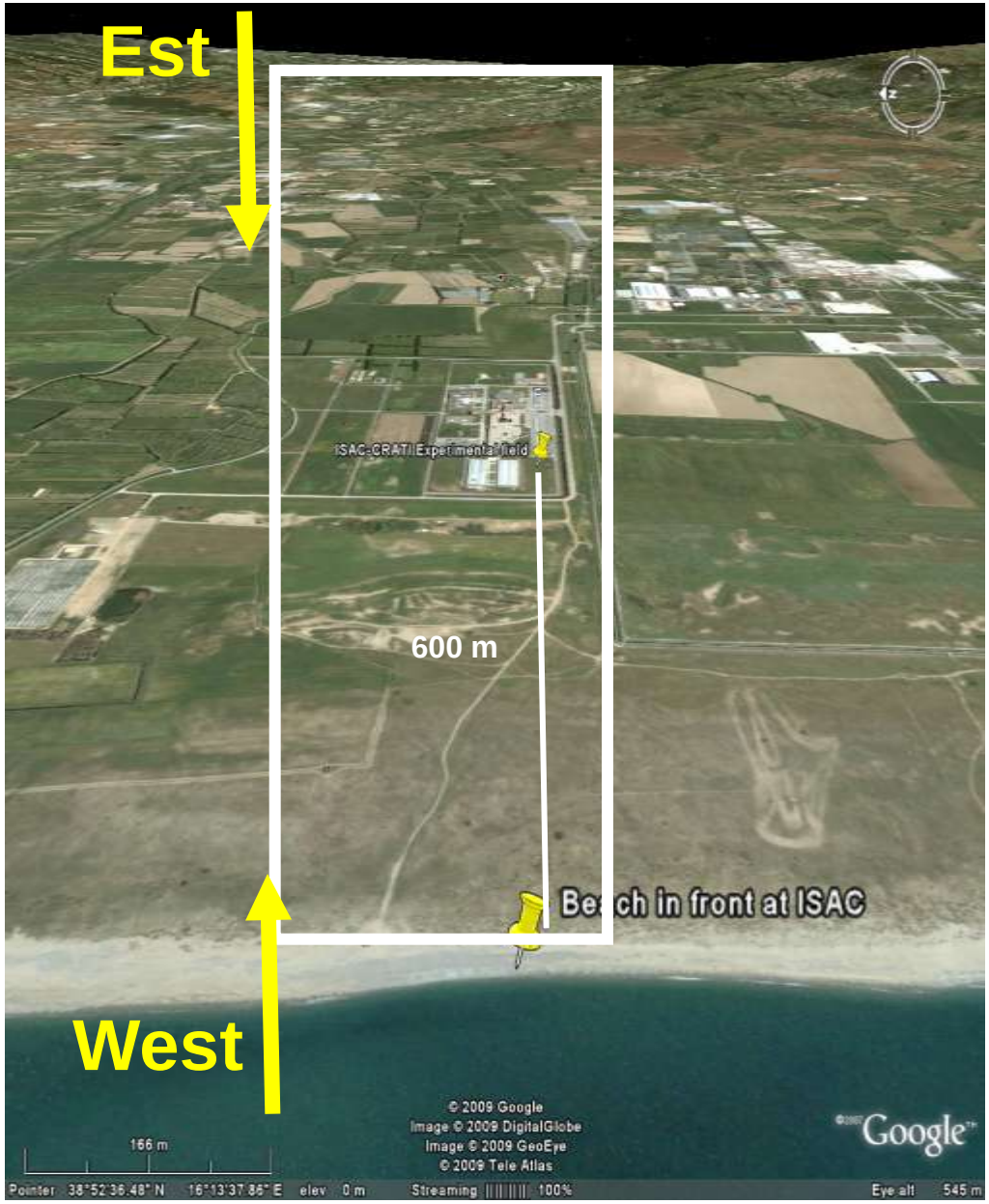
- Comparing remote sensing instruments
- Surface measurements

BACKGROUND: THE SITE

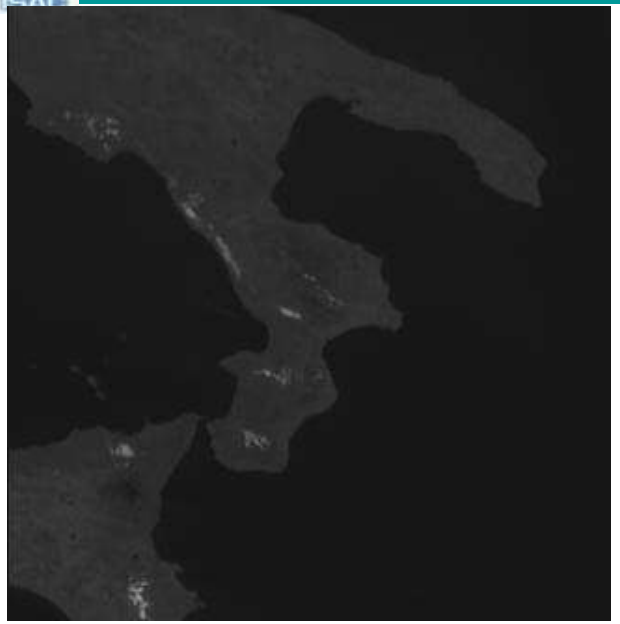


BACKGROUND: THE SITE

- Located at the west end of a West – Est oriented Valley
- Synoptic wind from the west
- East –West oriented breeze system
- The area is flat but influenced by
  - Valley/mountain and
  - Land/sea breeze



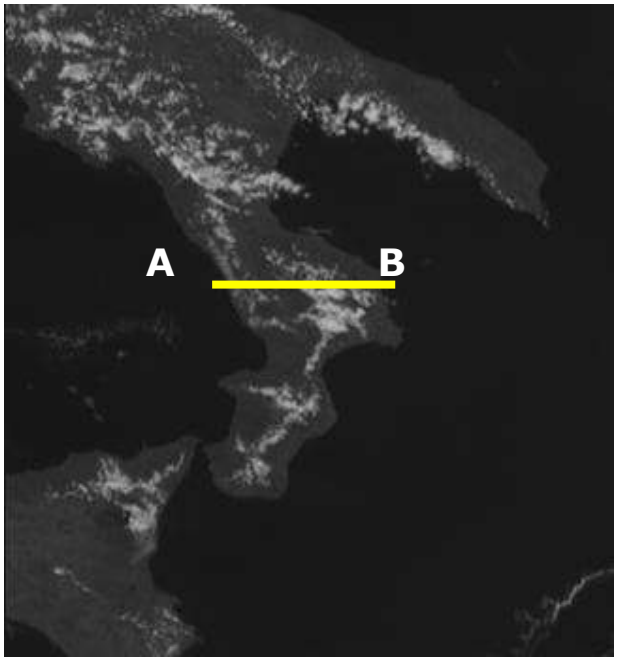
BACKGROUND: Interaction synoptic – breeze systems

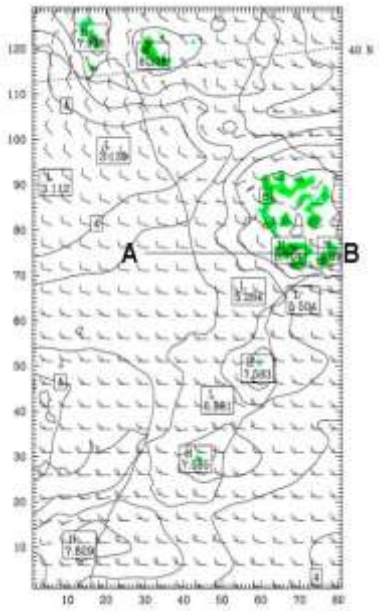


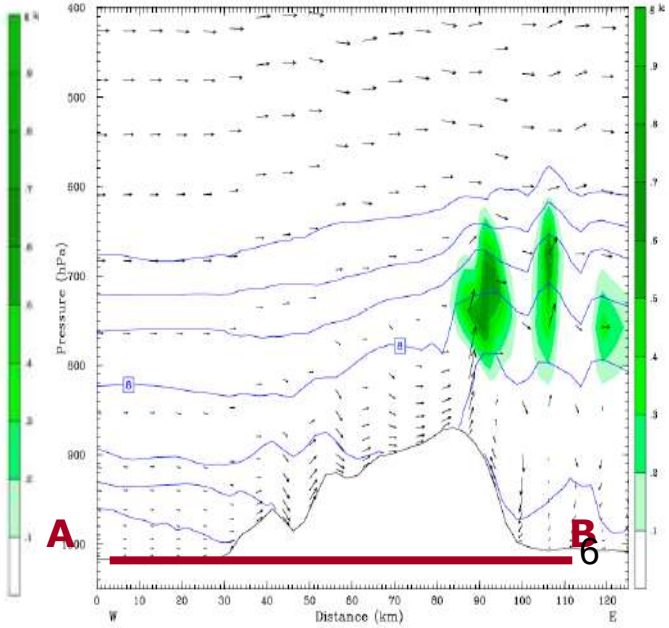
Light Sea Breeze

Sea Breeze & Synoptic flow

Severe tunderstorms might develop







BACKGROUND: ground-based remote sensing

Atmospheric ground based remote sensing includes:

Acustic (SODAR), optical (LIDAR) and electromagnetic (RADAR) devices

- Sound is backscattered at temperature gradients
- Light is backscattered at small particles (Mie scattering) or at air molecules (Rayleigh scattering).
- Electromagnetic signal is backscattered at small-scale fluctuations of T and especially moisture **q**.

Thermal structures and particles may then serve as

- Indicators of the atmospheric layering, or
- used to estimate i.e. U, T and q profiles

Ground-based remote sensing: LIDARS and SODARS

Here, we present results from two LIDARs and a SODAR

- LIDAR Ceilometer (*Vaisala CL31*) to monitor the layering of the atmosphere
- Wind LIDAR Doppler WindCube (*Leosphere*) to estimate vertical wind profiles
- SODAR (*METEK*) To estimate vertical wind profiles

EXPERIMENTAL SETUP

N

2 LIDARS

Ceilometer CL31 & Wind Cube

Meteo and turbulence mast

Meteo Mast

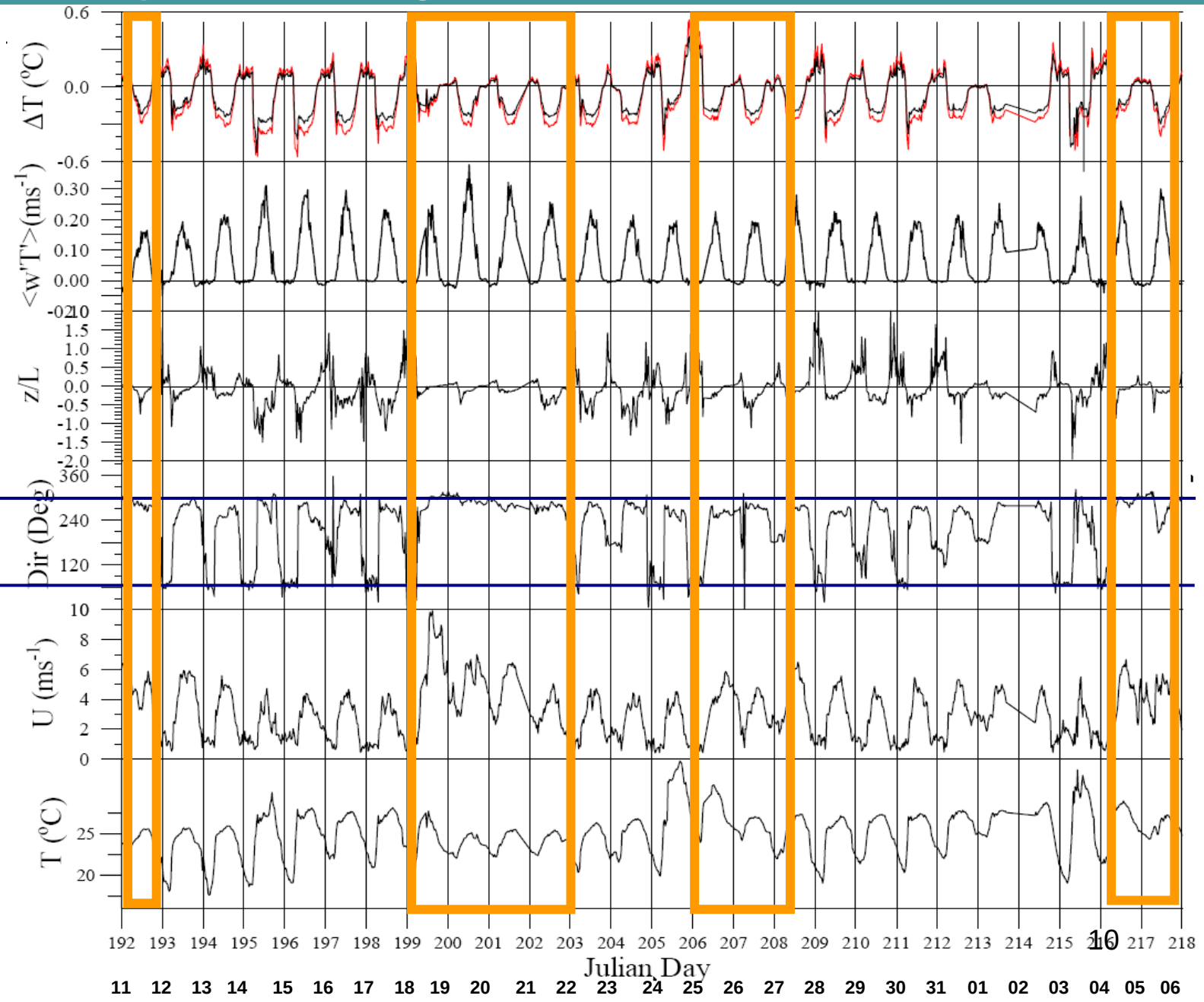
Metek sonic 9 m
NOAA Hygrometer IRGA 9 m
T absolute 9 m
DT at T_5- T_2 and T_9-T_5

11 July to 05 August 2009: Surface data

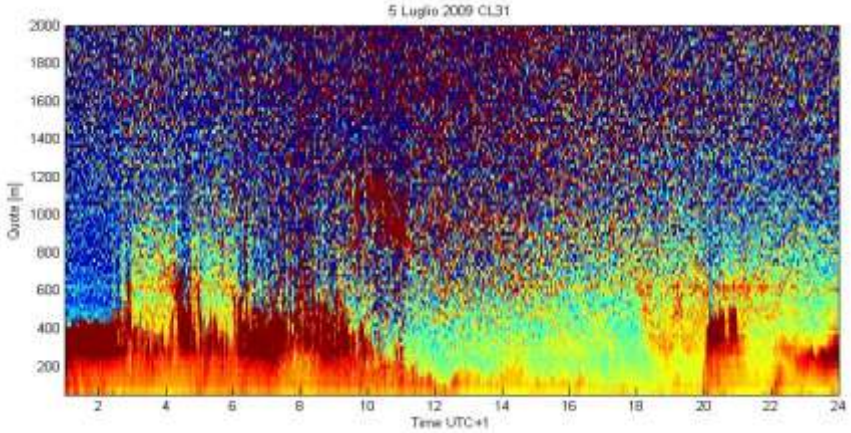
Synoptic

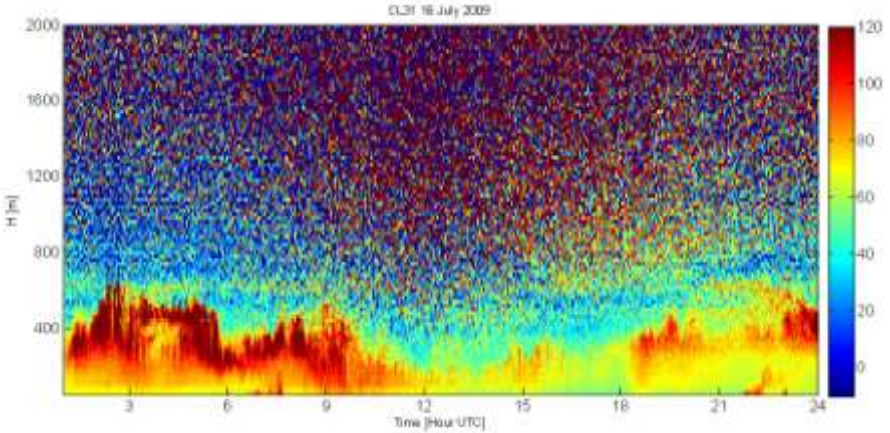
West

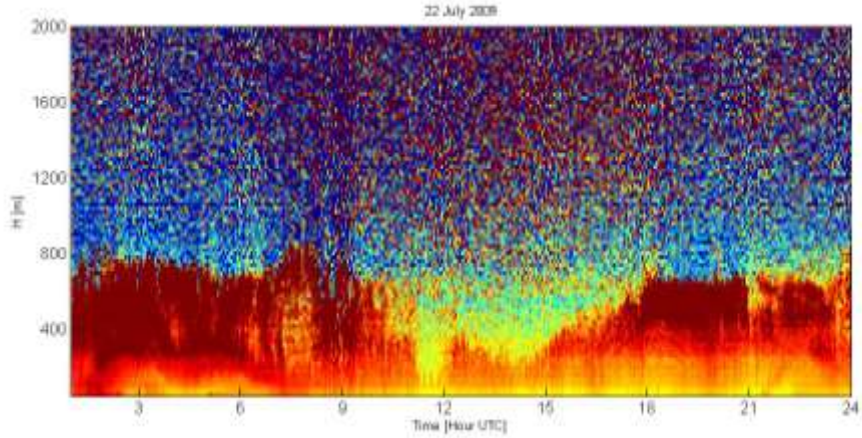
East

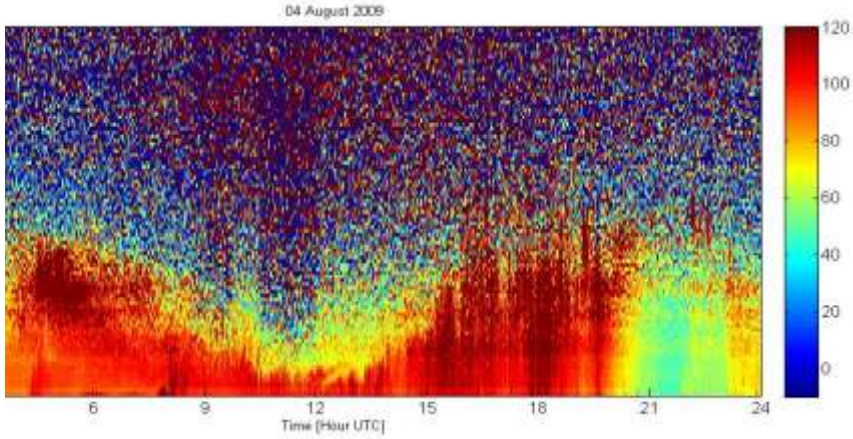


CEILOMETER: Sea breeze case

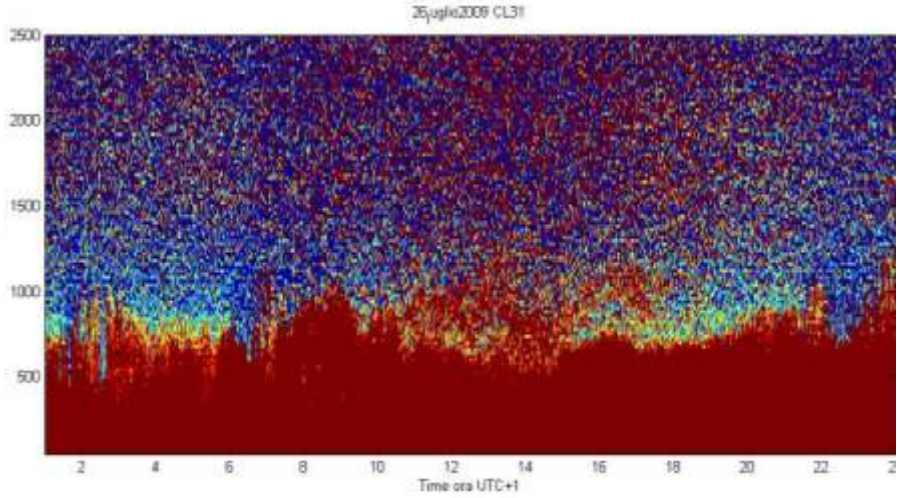


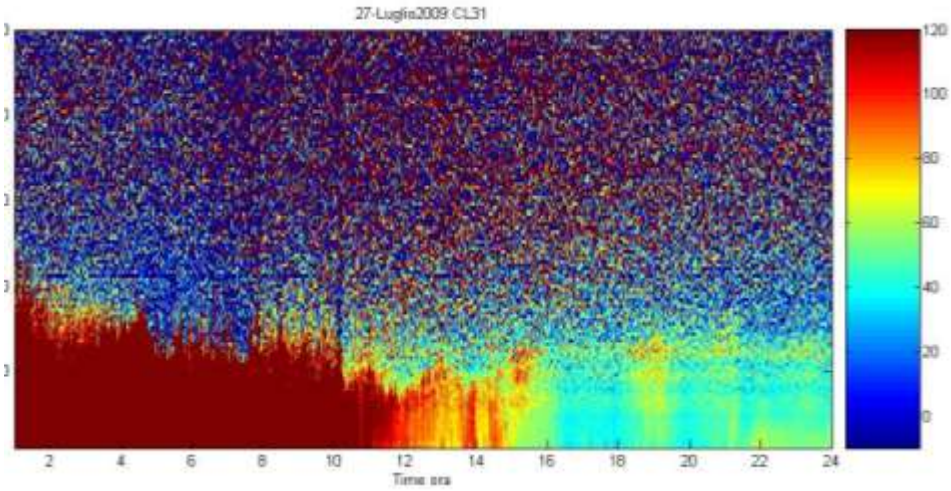






CEILOMETER: Synoptic case





CEILOMETER: The height of the BL

Backscatter Gradient method (blue)

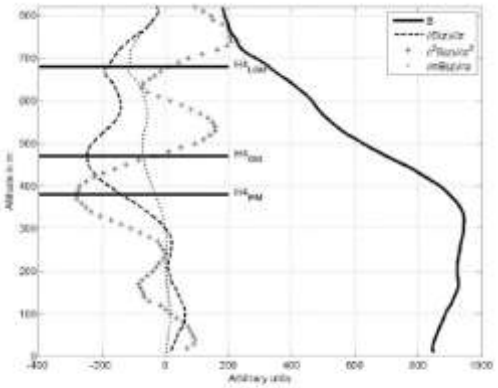


Figure 1: Schematic of the three gradient or derivative methods for MLH determination from optical remote sensing. B denotes the optical backscatter intensity.

Idealised Back scatter (red)

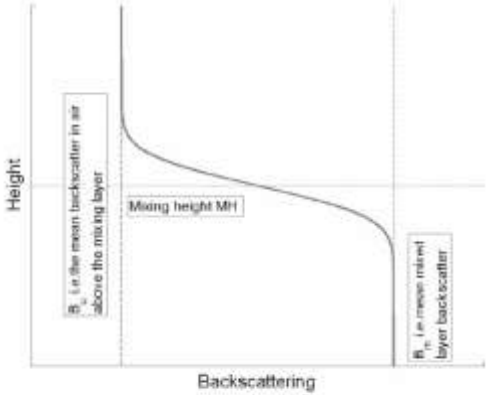
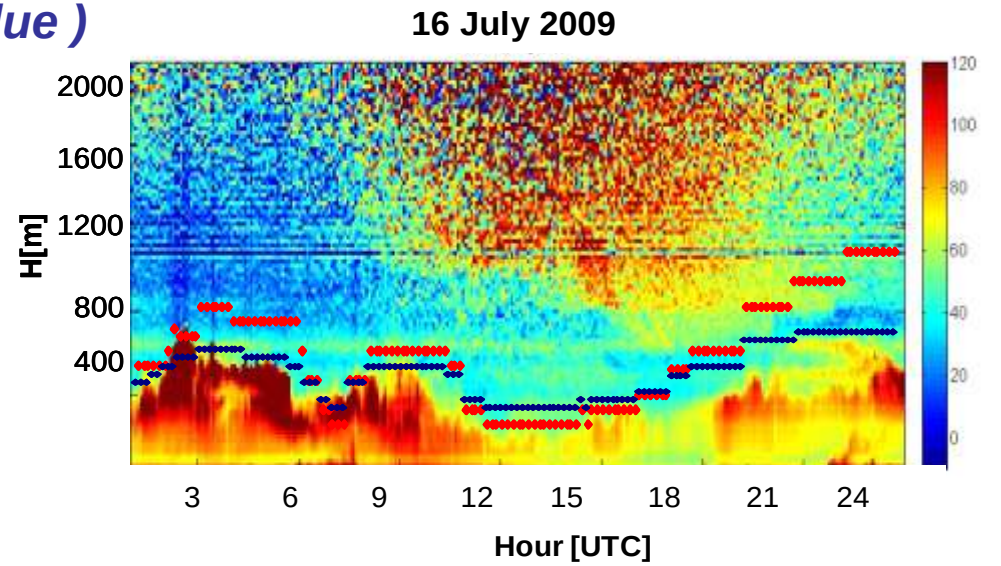
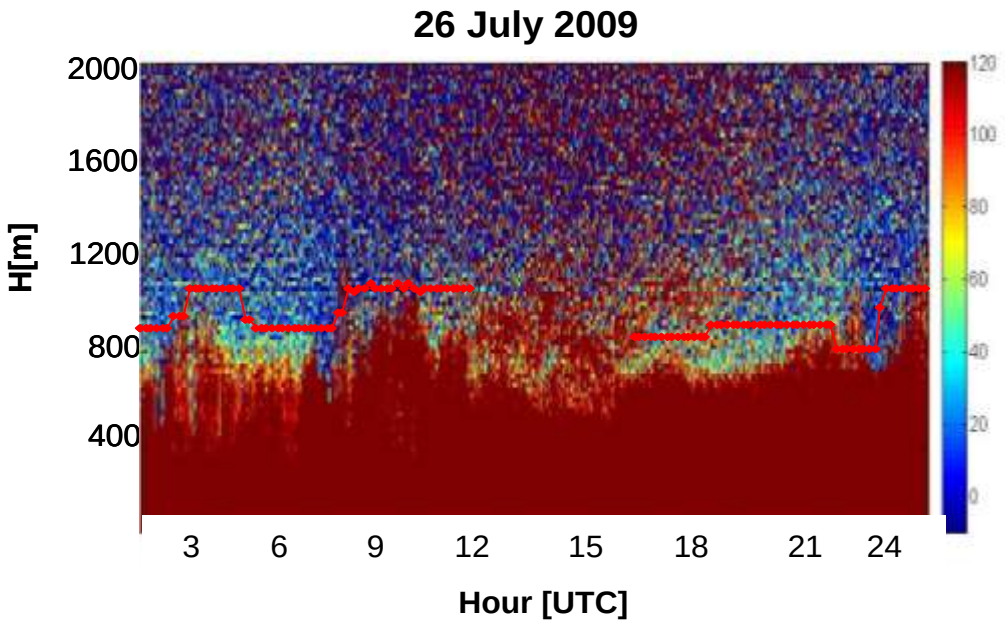
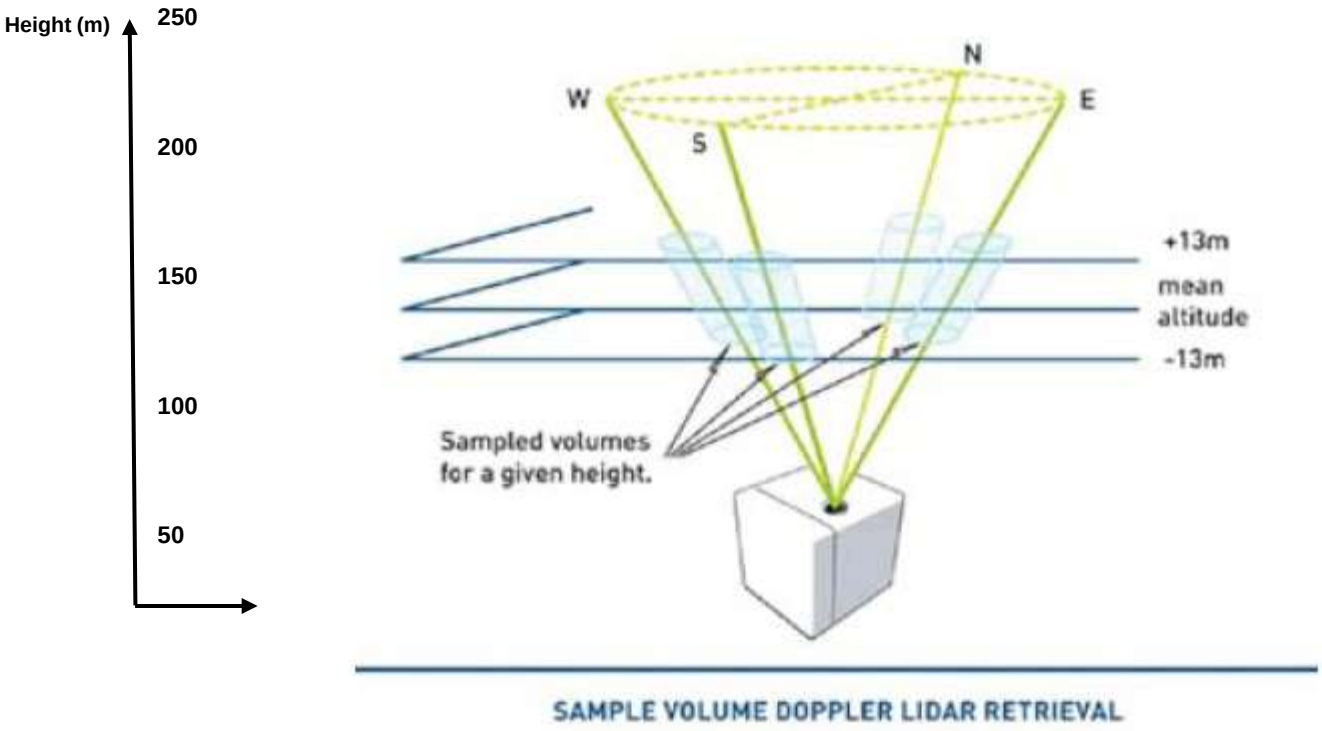


Figure 2: Schematic of the idealised gradient method from ERES-MAA et al. (2006).





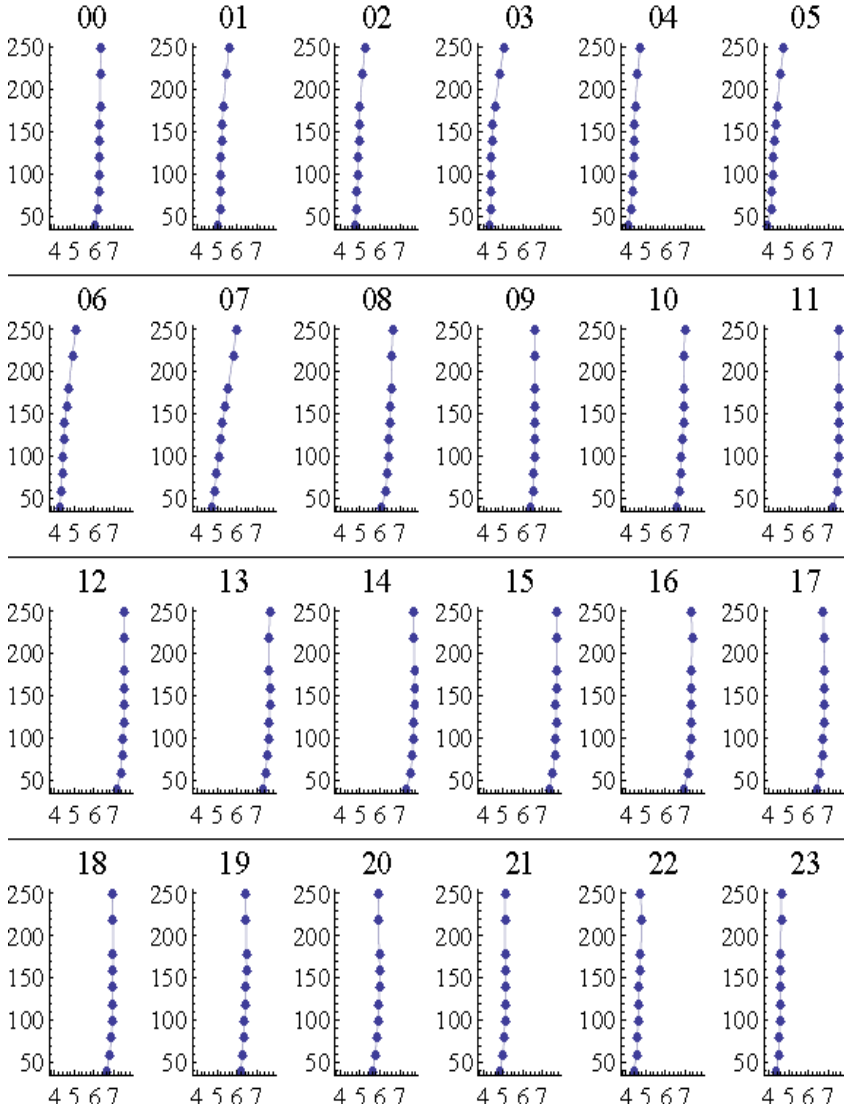
LIDAR Doppler : the Wind Cube by Leosphere



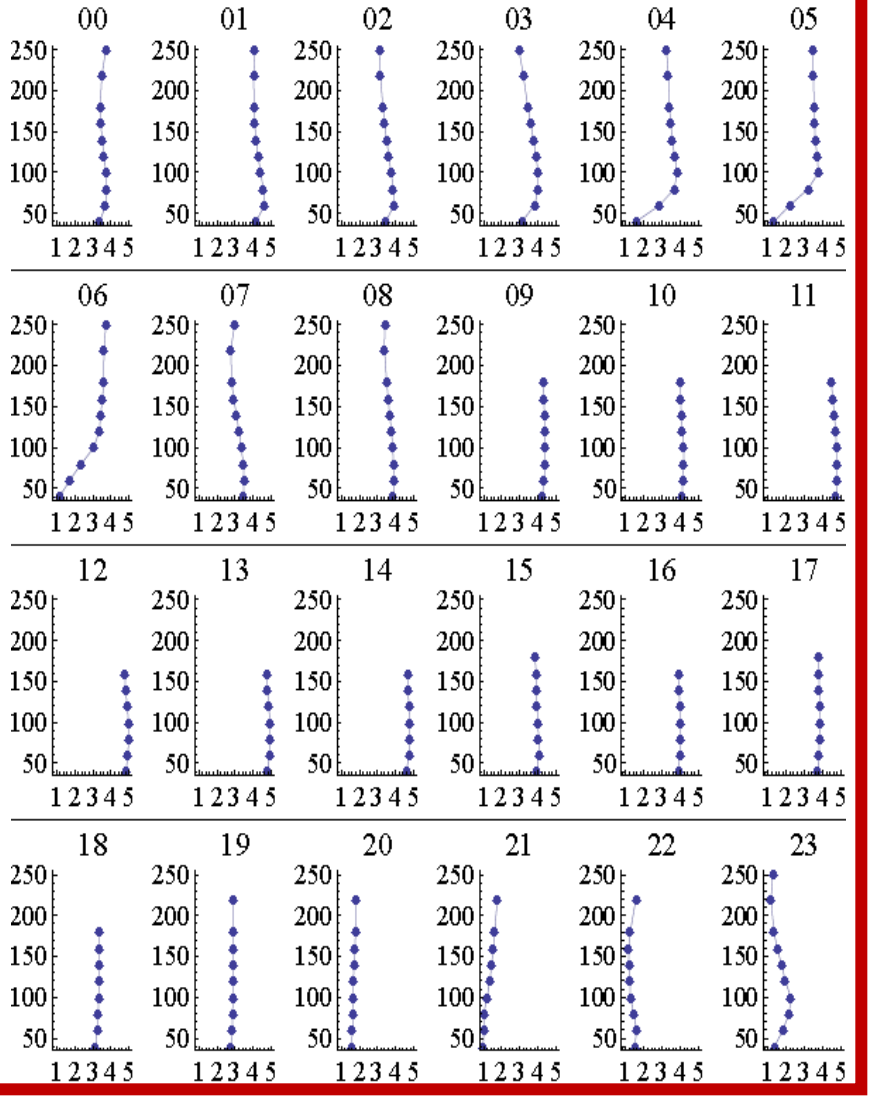
A LIDAR measures wind by determining the Doppler shift in laser beam returns as shown above. From the four light beams in the LIDAR, vertical and horizontal wind speeds are determined. The height of the measurement is determined by processing the time delay from transmits to receipt of the pulse. (Please refer to www.leosphere.com for additional information).

Wind cube : wind profiles

Synoptic flow

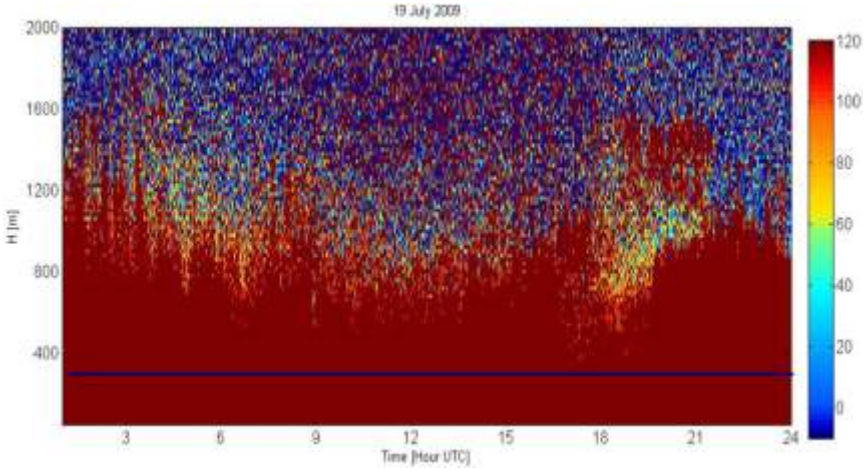


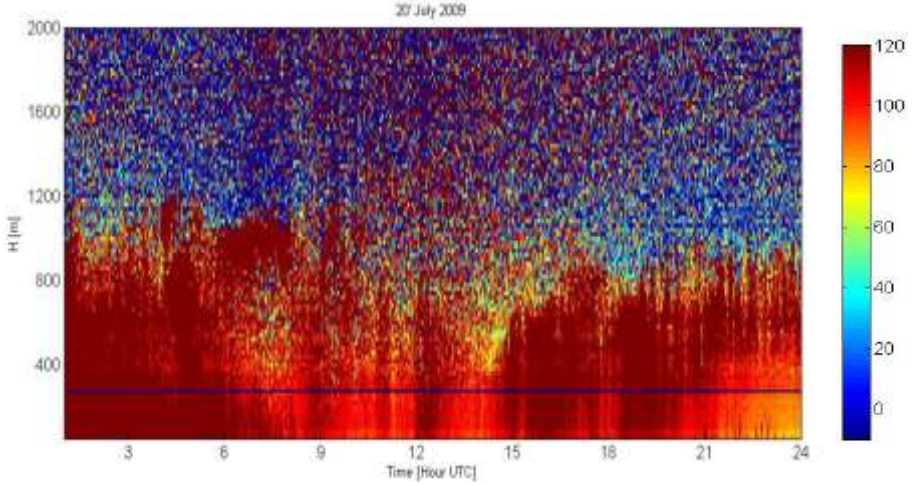
Sea Breeze



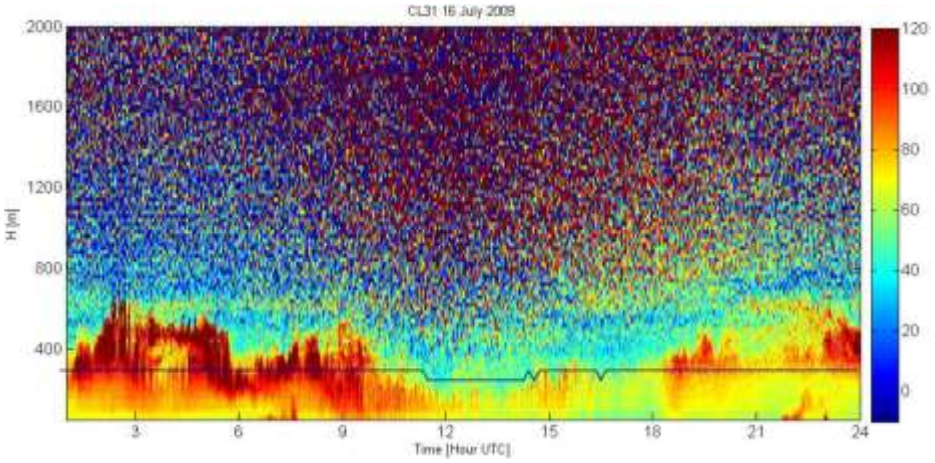
Measurement range of the Wind cube

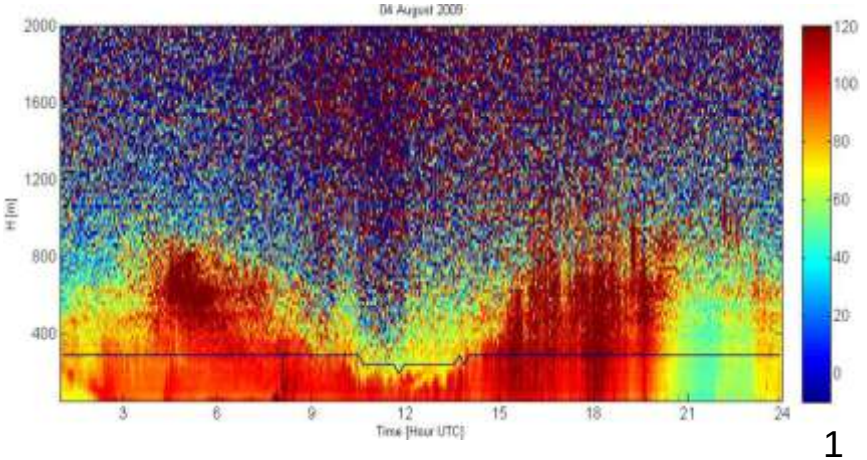
Synoptic flow



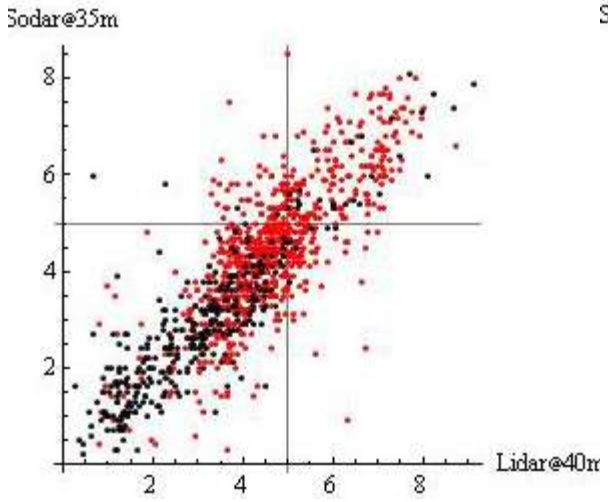


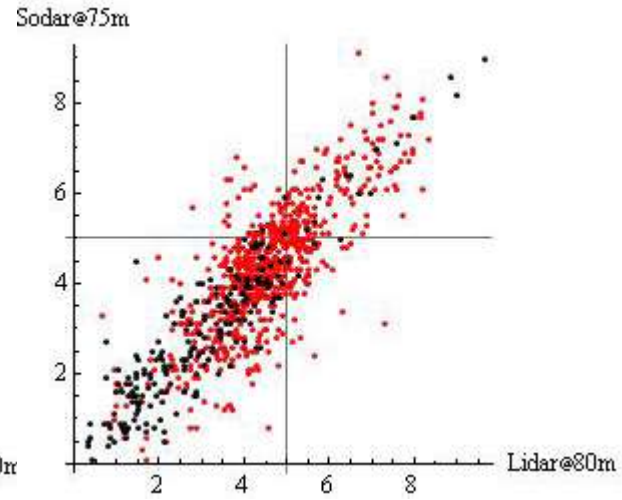
Sea Breeze

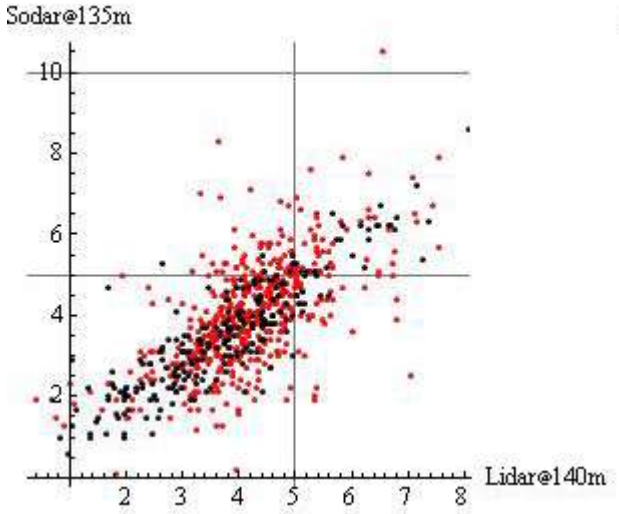


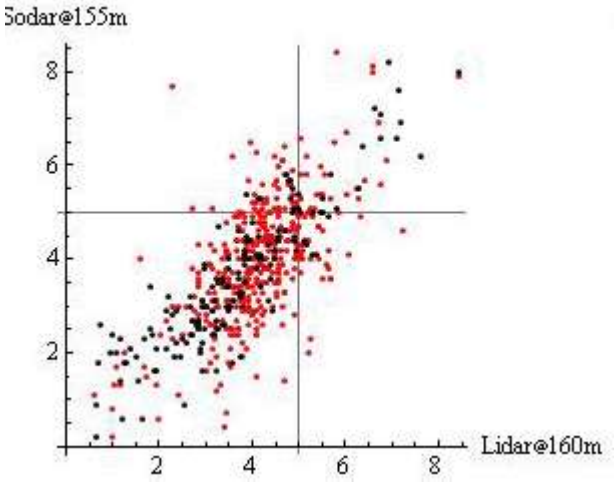


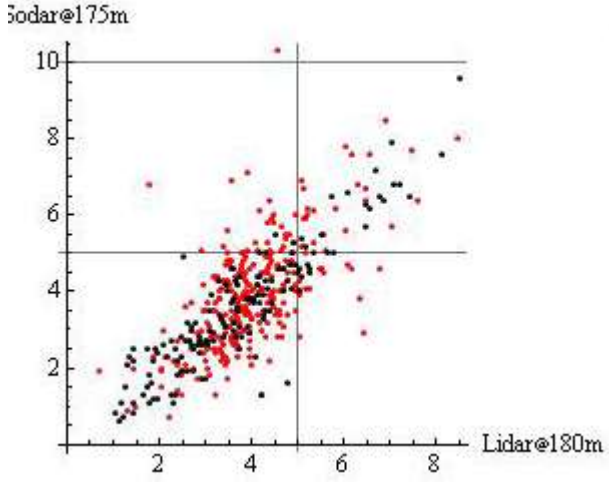
Wind cube & SODAR

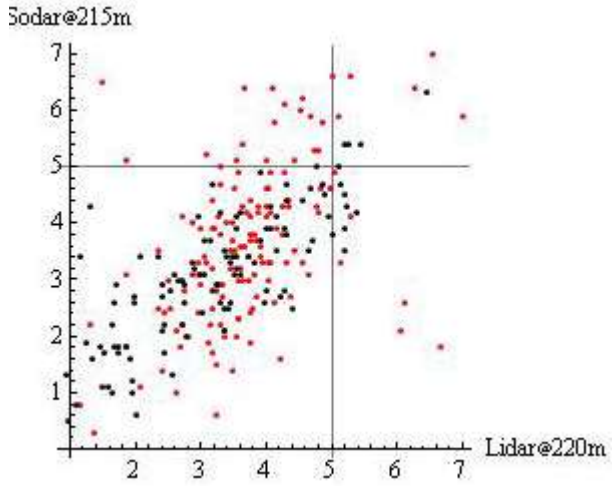










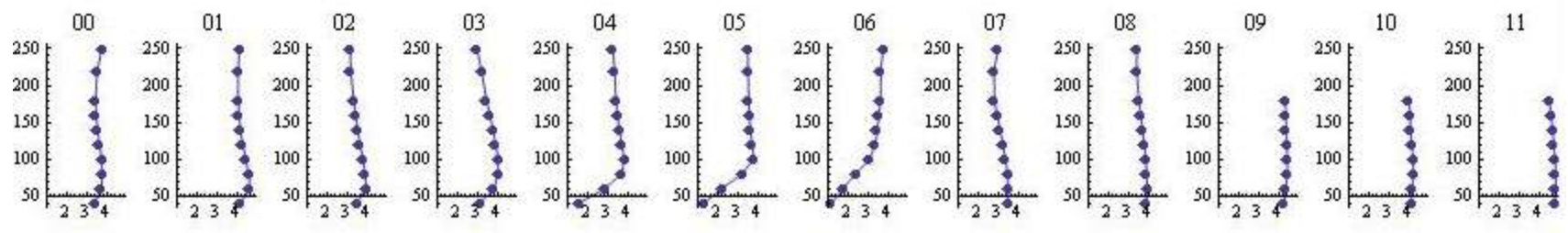


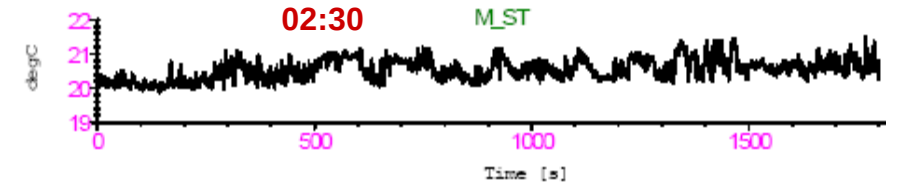
Summary

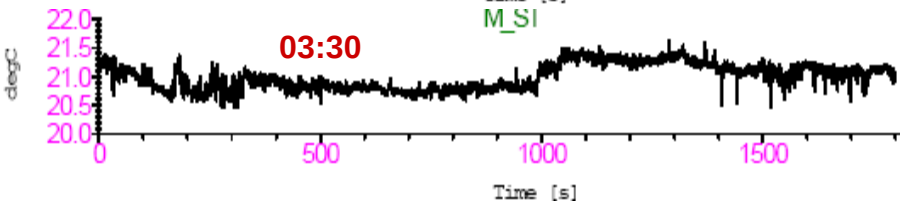
- **When the sea breeze starts an internal boundary layer IBL develops.**
- **When the sea breeze is well developed the IBL seems to merge into the convective BL**
- **The height of the discontinuity detected by the ceilometer varyes between 150 m and 1200 m**
- **Advanced data mining is needed to integrate measurements from different types of instruments, including Satellite.**
- **When fully evaluated, this database can be of use for assessing model performances.**

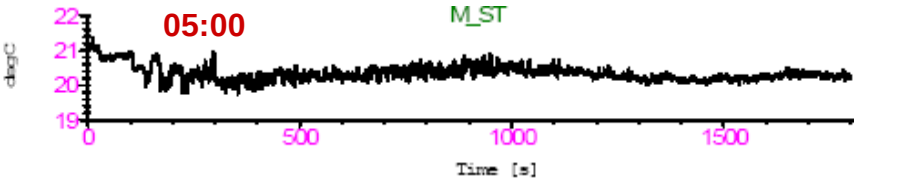
WORK IN PROGRESS: Turbulence, wind profiles and HBL

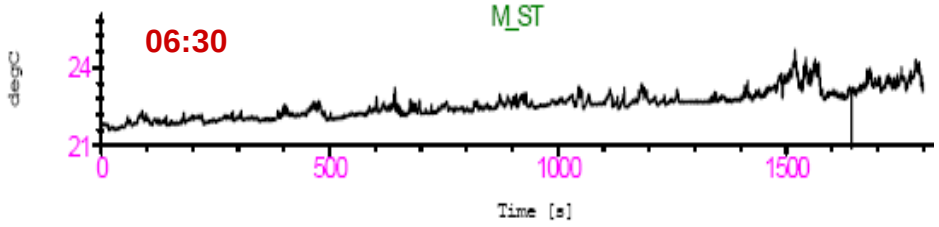
16 July

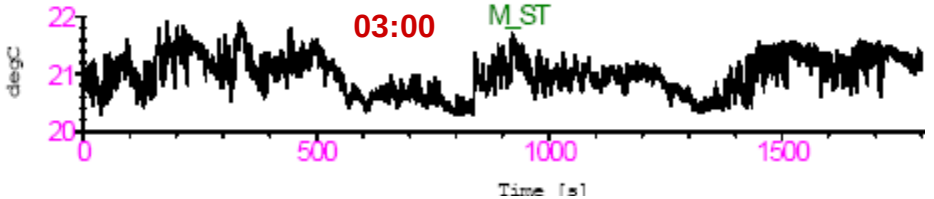


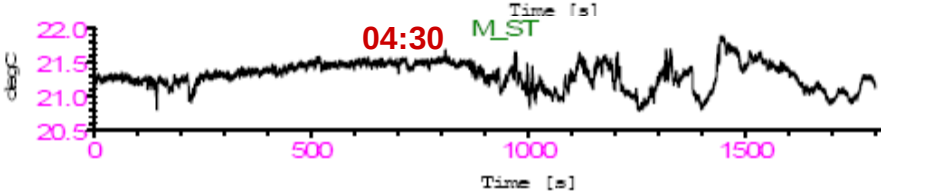


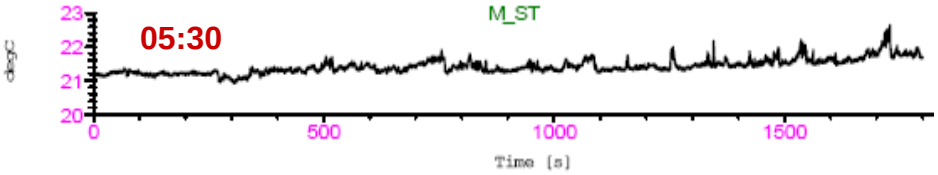


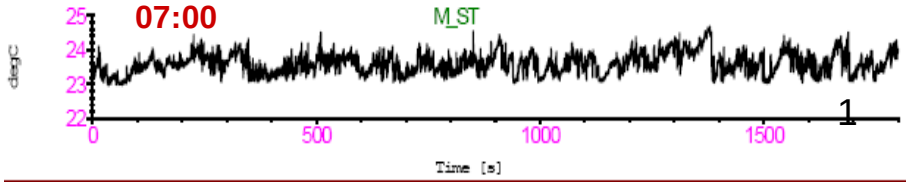












THANK YOU FOR YOUR ATTENTION